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A systematic reassessment of the genus *Microchaetus* Rapp, 1849: its amended definition, reinstatement of *Geogenia* Kinberg, 1867, and erection of a new genus *Kazimierzus* (Oligochaeta: Microchaetidae)

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ABSTRACT

The endemic South African genus *Microchaetus* Rapp, 1849, considered to be composite, is restudied. Three groups of species are recognised and separated into three genera. Species *braunsi*, *decipiens*, *klopperi*, *papillatus*, *rappi*, *stuckenbergi* and *vernoni* are left in *Microchaetus*, with *microchaetus* as the type species. Genus *Geogenia* Kinberg, 1867 is reinstated for *ambita*, *benhami*, *caementerii*, *distasmosa*, *gripha*, *herberti*, *idechorita*, *madida*, *mkuzi*, *montana*, *namaensis*, *parva*, *pentheri*, *pondoana*, *quera*, *ritae*, *rivus*, *tegwana*, *tuberosus* and *zaloumisi*, with the type species *natalensis*. For *alipentus*, *circulatus*, *crousi*, *davidi*, *franciscus*, *guntheri*, *hamerae*, *imitatus*, *ljungstroemi*, *metandrus*, *obscrus*, *occidualis*, *occiduus, pauli*, *pearsonianus*, *pentus*, *peringuei*, *rosai*, *senarius*, *sirgeli* and *sophieae*, occurring in western and south-western parts of South Africa, and characterised by distinct features, the new genus *Kazimierzus* gen. n. is established, with *hamerae* designated as the type species.

Descriptions of the familial characters, corresponding with those originally given by Michaelsen (1900, 1918, 1928), augmented by Gates (1959), Brinkhurst and Jamieson (1971), and Plisko (1996*a*, 2006), and emended on the basis of the present study, are provided. A key is presented for all currently recognised genera of Microchaetidae. Keys to the species of *Microchaetus* (*s. str.*), *Geogenia* and *Kazimierzus* gen. n. are given. Checklists of reclassified species, their synonymy, and notes on their occurrence, are provided. The distribution of each genus dealt with in this study is mapped.

KEY WORDS: Clitellata, Oligochaeta, Microchaetidae, *Geogenia*, *Kazimierzus*, *Microchaetus*, taxonomy, revision, new genus, new combinations, South Africa.

INTRODUCTION

The discovery of microchaetids goes back to the middle of the 19th century, when Rapp (1849) named a giant South African earthworm as *Lumbricus microchaetus*, with an associated proposal for a new genus named *Microchaetus*. The collection site was broadly indicated as 'Cape', which was imprecise, referring to the southern part of South Africa. The next described species was *natalensis*, recorded by Kinberg (1867) from a site named 'Port Natal', now Durban in KwaZulu-Natal. Kinberg, recognising external differences between these two South African species, and probably considering the distance between their type localities, erected the new genus *Geogenia* for his species. However, the inadequate species descriptions created taxonomic problems for decades, leading to doubts and deliberations about species validity and generic status (Perrier 1886; Beddard 1895; Michaelsen 1899*b*, 1900). Michaelsen (1913*c*, 1918, and his unpublished letters addressed to Dr Warren, former Director of the Natal Museum, in the archives of the Natal Museum) later accepted the validity of *natalensis*. Having restudied the type material, the specimens examined by Michaelsen, and a large new collection of this species gathered in the Natal Museum, Plisko (1991*a*, 1992) confirmed its validity, but left the generic name in synonymy of *Microchaetus*.

A proposed reinstatement of *Geogenia* for *natalensis* and for some other species—not adequately documented by Ljungström in shared information with Pickford (1975), Brinkhurst and Jamieson (1971), and in Ljungström's draft of an unpublished manuscript on microchaetids—prompted remarks and uncertainties (Pickford 1975; Plisko 1992). Reinecke and Ryke (1969) described the proandric species *lesothoensis* in *Geogenia*, but did not document reasons for the reinstatement of this genus. The species has been affiliated to *Proandricus* after redescription (Plisko 1994). Afterwards, all holonephric microchaetids recorded from South Africa were placed in *Microchaetus*. Having withdrawn a group of proandric species from *Microchaetus* and creating the new genus *Proandricus* for them, Plisko (1992) left all other species in *Microchaetus*. The features characterising the latter genus, based on those primarily proposed by Beddard (1886*a*), Michaelsen (1900, 1918), Brinkhurst and Jamieson (1971), and subsequently by Plisko (1992, 2005, 2006), were: (1) holandric or metandric arrangement of testes and male funnels, (2) presence of one oesophageal gizzard in segment 7, and (3) holonephric excretory condition (with no differentiation of the bladder shapes).

For decades these characters provided a simple generic recognition of *Microchaetus*. However, various other features noted during species identifications, and subsequently employed in species descriptions, resulted in the creation of a composite genus. After extensive study of the broad ranges of selected features, and correlations of the distinctive characteristics, lineages within this genus were noted (Plisko 2006). The species assigned to *Microchaetus* (*s. l.*) were then restudied. Three distinct groups of species, each with shared features, were distinguished, and as a result three genera are now recognised and elaborated in this paper.

Eight species, related to *Microchaetus microchaetus*, are left in the genus *Microchaetus* Rapp, 1849 (*s. str.*). The genus *Geogenia* Kinberg, 1867 is reinstated to accommodate 21 species showing similarity to *natalensis*. A new genus *Kazimierzus* gen. n. is created for another 21 species with a distinctive suite of characters, occurring in western and south-western parts of South Africa.

MATERIAL AND METHODS

The majority of type specimens studied are housed in the Natal Museum, Pietermaritzburg, South Africa. Those used in this study and held in other institutions, are listed below.

Microchaetus braunsi: Zoological Museum of Humboldt, Berlin (type material); Zoological Museum and Institute, University of Hamburg, Germany (other material).
M. microchaetus: Natural History Museum, Vienna, Austria (type material).
M. papillatus: Natural History Museum, London, United Kingdom (type material).
M. rappi: Natural History Museum, London, United Kingdom (type material).
Geogenia benhami: Zoological Museum and Institute, University of Hamburg (type material); Natural History Museum, Vienna, Austria (material examined by Michaelsen), United States Natural Museum, USA (Pickford material).
G. caementerii: Zoological Museum and Institute, University of Hamburg (type material).
G. pondoana and *namaensis*: Zoological Museum of Humboldt, Berlin (type material); Zoological Museum and Institute, University of Hamburg (other material).
G. natalensis: Naturhistoriska Riksmuseet, Stockholm, Sweden (type material).

G. pentheri: Natural History Museum, London, United Kingdom (type material).
Kazimierzus crousi, *franciscus*, *guntheri*, *pearsonianus*: United States Natural Museum USA (type material);
K. ljungstroemi (holotype), *pearsonianus* (holotype and other material): South African Museum, Cape Town, South Africa;
K. rosai: Zoological Museum of Humboldt, Berlin (type material); Zoological Museum and Institute, University of Hamburg (other material).

New material of *G. benhami*, *G. pondoana*, *G. natalensis*, *M. papillatus*, *G. caementerii*, *G. pentheri* and *K. franciscus* was also examined. The type material of *K. peringueyi* was not studied, but published information was adequate for its identification.

The familial characters for Microchaetidae, as this family is presently understood, are elaborated and summarised. A key is given to six genera presently recognised. Keys to the species now classified in *Microchaetus* (*s. str.*), *Geogenia* and *Kazimierzus* gen. n. are presented. Listings of these species, with their synonymy and notes on their occurrence, are provided. The species are characterised in the keys. It is reasonable to expect that by using these data, augmented by original descriptions, with information added in redescriptions, it should be possible to identify the species. However, careful attention should be paid to evaluation of dimensions, segment number, the length and extension of clitellum, and in some cases an extension of seminal vesicles, because due to different maturity states of individuals these characters may vary slightly.

Distributions of *Microchaetus*, *Geogenia and Kazimierzus* are illustrated in Figs 1–3. The terminology used follows previous publications (Plisko 1992, 1993*a*, 2005, 2006); however, the term 'spermiductal funnels' used previously is replaced in this paper by 'male funnels'.

TAXONOMY

Family Microchaetidae Beddard, 1895

Microchaeta Perrier, 1881: Benham 1886*a*, 1886*b*, 1892; Beddard 1886*a*, 1886*b*, 1891, 1895; Rosa 1887, 1891, 1897, 1898; Michaelsen 1899*a*, *b*.
Geoscolecidae (*Microchaeta*): Benham 1890.
Geoscolecidae [*partim*]: Rosa 1891, 1893 [inclusion of *Microchaeta* species].
Microchaetinae (Geoscolicidae) [*partim*]: Beddard 1895: 664 [inclusion of *Microchaeta* species; incorrect emendation of Geoscolecidae; the name 'Microchaetidae' is used on page 664].
Microchaetinae (Glossoscolecidae): Michaelsen 1900: 447; 1910: 158; 1913*c*: 422; Stephenson 1930: 899 [*partim*]; Pickford 1975: 17.
Glossoscolecidae [for *Microchaetus* species]: Michaelsen 1913*a*: 542.
Microchaetinae (Lumbricidae): Michaelsen 1918: 305.
Microchaetidae (Lumbricina): Michaelsen 1928: 107.
Microchaetini (tribe in Glossoscolecinae): Brinkhurst & Jamieson 1971.
Microchaetidae: Gates 1959: 255; Ljungström & Reinecke 1969: 215; Reinecke & Ryke 1969: 515; Reynolds & Cook 1976: 2; Omodeo 1998: 53; 2000: 184; Sims 1978: 662; 1980: 110; 1982: 285; Jamieson 1980: 268; Hodgson & Jamieson 1992: 57; Reynolds 1993: 2; Zicsi & Pajor 1992: 129; Plisko & Zicsi 1991: 111; Plisko 1992: 337; 1996*a*: 288; 2005: 104; 2006: 17–42 [and in all other papers dealing with microchaetids].

The following account of family characters is based on those published for Microchaetinae, Microchaetidae or Microchaetini (Beddard 1895; Michaelsen 1900, 1918, 1928; Gates 1959; Brinkhurst & Jamieson 1971; Plisko 1996*a*, 2006), and augmented in the present study.

Diagnosis: Testes and male funnels set in holandric, proandric or metandric arrangement. Excretory system holonephric or meronephric; holonephridia with nephridial bladers V- or J- shaped. Gizzards oesophageal; one or two, present in segments 6, or 6–7, or 7, or 6–7 and 9; encircling oesophageus, horseshoe-shaped, or as separated dorsolateral glands. Dorsal blood vessel variable: simple through the whole body, or double in certain preclitellar segments, and being simple or double when crossing septa. Calciferous glands oesophageal, restricted to one or two segments, in area 9–11. Spermathecae tubular or globular, in simple pairs, or multiple. Intestine commencing in 12, 13 or 14. Typhlosole present, commencing immediately with intestine, or posterior to intestine segments. Vasa deferentia uncovered, or embedded in body wall. Seminal vesicles paired or fused dorsally, confined to one or to two segments, or stretching posterior to one or more segments. Ovaria in 13. Septa variably thickened in various anterior segments. Spermathecal pores in pre-testis, testis, or post-testis intersegmental furrows, or intra-segmentally. Female pores paired in 14, or in 13/14. Male pores paired, post-testicular, in clitellar area, intersegmental or intrasegmental.

Secondary annulation on preclitellar segments present, variable. Body length and segment number highly variable. Setae in lumbricinae arrangement, in regular rows, or in a few preclitellar or postclitellar segments irregularly settled. Nephridial pores present or absent. Clitellum and tubercula pubertatis present in mature individuals, located variably. Papillae present or absent. Genital glands present or absent; if present, variable in size, shape and location. Dorsal pores absent. Copulatory sacs absent. Prostates absent.

Notes: Six genera now constitute the family, i.e. *Microchaetus* emend., *Geogenia* stat. rev. and *Kazimierzus* gen. n. (considered in this paper), *Tritogenia*, *Michalakus* and *Proandricus*. The genera *Microchaetus* and *Geogenia* comprise species with holandric, holoic conditions. *Kazimierzus* gen. n. consist of holandric and metandric species, with holoic excretory system. *Tritogenia* and *Michalakus* are constituted by holandric, meronephric species. *Proandricus* species are characterised uniformly by the proandric condition.

Distribution: The entire family Microchaetidae, as it is presently recognised, is restricted to southern Africa. Its representatives are known from South Africa, Lesotho and Swaziland. Occurrence of some species might be expected in adjacent parts of Mozambique, Zimbabwe and possibly also Botswana.

Key to genera of Microchaetidae

1 Excretory system meronephric; nephropores absent 2

– Excretory system holonephric; nephropores present; only one gizzard present, in segment 7 3

2 One gizzard in segments 6 or 6–7 .... *Tritogenia* Kinberg

– Two gizzards; one in segments 6–7, second in segment 9 .... *Michalakus* Plisko

3 Testes and male funnels in proandric arrangement................. *Proandricus* Plisko

– Testes and male funnels in other than proandric arrangement 4

4 Testes and male pores in holandric arrangement; nephridial bladders V-shaped; dorsal blood vessel double in certain preclitellar segments, simple when crossing septa 5

– Testes and male pores in holandric or metandric arrangement; nephridial bladders J-shaped; dorsal blood vessel simple through whole body. Two or one pair of seminal vesicles confined to one, two, or extended in more segments; some of septa 4/5–9/10 variably thickened. Mature individuals 80–500 mm, 135–500 segments .... **Kazimierzus** gen. n.

5 Spermathecae always posterior to testis locations; spermathecal pores in four 12/13, 13/14, 14/15, 15/16 or five 12/13, 13/14, 14/15, 15/16, 16/17 intersegmental furrows; occasionally in some conspecific populations a posterior row of spermathecae and their pores (16/17 or 15/16) are reduced; septa 4/5, 5/6, 7/8, 8/9 thickened firmly. Mature individuals large; length nearly 1 meter or more, some species extending to more than 2 meters; segment number over 500, can exceed 1200 .... *Microchaetus* Rapp, **emend.**

– Spermathecae present anterior or posterior to testis locations, or in testicular segments; spermathecal pores in one, two, three or more intersegmental furrows; if in more furrows, the anterior pairs of spermathecal pores occur anterior to, or in testis segments; two, three, four or five septa 4/5–8/9 selectively, variably thickened. Mature individuals small or medium, not reaching more than 500 mm in length; segment number 100–500 .... *Geogenia* Kinberg, **stat. rev.**

Genus *Microchaetus* Rapp, 1849, **emend.**

Microchaetus: Rapp 1849: 143; Michaelsen 1900: 447; 1907: 5; 1913*a*: 538; 1913*b*: 306; 1913*c*: 422; 1918: 306; 1928: 107 [in all papers *partim*]; Stephenson 1930: 900 [*partim*]; Brinkhurst & Jamieson 1971: 739 [*partim*]; Pickford 1975: 23 [*partim*]; Reynolds & Cook 1976: 56 [*partim*]; Plisko 1991*b*: 293; 1999: 269; [in the following papers *partim*]: 1991*a*: 286; 1992: 338; 1993*b*: 222; 1995*b*: 45; 1998: 250; 2002: 205; 2003: 281; 2005:105; 2006: 30–32.

Lumbricus: Rapp 1849: 142; Perrier 1881: 239; Beddard 1884: 570; 1886*a*: 63; Reynolds & Cook 1976: 136 [for *Microchaetus microchaetus*].

Anteus: Perrier 1872: 49 [for *microchaetus*].

Antaeus: Vaillant 1890: 183 [invalid emendation of *Anteus*].

Microchaeta: Perrier 1881: 239 [invalid emendation of *Microchaetus*]; Beddard 1886*a*: 63; 1895: 667 [*partim*]; Benham 1886*a*: 63; 1886*b*: 306; 1892: 141; Horst 1891: 77; Rosa 1891: 380; Michaelsen 1891: 207.

Microchaeta?: Vaillant 1890: 185.

Rappia: Vaillant 1890: 186 [for *Microchaeta*]; Reynolds & Cook 1976: 60.

Type species: *Lumbricus microchaetus* Rapp, 1849, by monotypy.

Diagnosis: Testes and male funnels in holandric arrangement. Excretory system holonephric with nephridial holoic bladders V-shaped. One oesophageal gizzard in segment 7. Dorsal blood vessel double in 4–9, being partly or fully separated when passing segments, but simple when crossing septa; in segment 8 broadly parted, in 9 enlarged, constituting 'cordiform' organ; posterior to septum 9/10 simple. Calciferous glands not stalked; encircling oesophagous with vestigial dorsal and ventral grooves, in one or two segments: 10, or 9–10, or 10–11. Spermathecae in post-testicular segments; multiple per segment. Spermathecal pores in four (occasionally in three), or five intersegmental furrows, with all pores always behind both pairs of testes. Four septa 4/5, 6/7, 7/8, 8/9 thickened variably, although firmly. Clitellum and tubercula pubertatis extended on numerous segments.

Body length extending to nearly or over 1 meter, sometimes more than 2 meters. Corresponding with large body length, a large number of segments present, average over 500, sometimes more than 1200 segments.

Comments: The species now classified in *Microchaetus* (*s. str.*) are characterised by a cluster of features warranting their separation from other microchaetids that were previously considered congeneric. These characters are: clitellum and tubercula pubertatis extended on numerous segments; four septa (4/5, 5/6, 7/8, 8/9) muscularly thickened; multiple spermathecae and spermathecal pores in four or five post-testicular segments; extreme body length; large segment number. However, it is noteworthy that the number of spermathecal pores observed in certain populations of some species demonstrates variability. For example, the spermathecae are found in four, or occasionally five furrows in *papillatus*; in *vernoni*, in four or three furrows. Such variability in species known from single specimens still has to be ascertained.

The species of this genus are known from a small number of sites in widely separated areas, spread over the eastern part of Western Cape, Eastern Cape, and the southern part of KwaZulu-Natal. Gaps in observed species distribution could be due to sampling bias. Representatives of these species are large, and live deeply in the soil—their collection is usually possible only where their activities bring them near to the surface. However, no large casts excreted onto the surface, characteristic for the species of this genus, have been recorded from any other sites. It should be noted that the reported occurrence of *Microchaetus* species in the Cape Peninsula might be erroneous. Similarly, the locality of a single sample of *rappi* reported by Beddard (1886*b*), as 'Breakwater, Cape Town', was later, although by an unknown person, corrected on the collection-label as 'Cape of Good Hope' and so cited by Plisko (1999). Specimens of *rappi*, *decipiens* and *braunsi* collected in the districts of Avontuur, Port Elizabeth and Grahamstown (Beddard 1886*b*; Michaelsen 1899*a*, 1910), indicate the occurrence of these species in the eastern part of Western Cape and the southern Eastern Cape. The type localities of *klopperi* in the Adelaide neighbourhood and *stuckenbergi* near Stutterheim extend the range of the genus in Eastern Cape. *M. vernoni* and *papillatus* were found in southern KwaZulu-Natal (Vernon Crookes Nature Reserve and the Pietermaritzburg district) showing the occurrence of this genus to the north. The distribution of *Microchaetus* is shown in Fig. 1.

Key to species of *Microchaetus* (*s. str.*)

1 Spermathecal pores in four intersegmental furrows 12/13, 13/14, 14/15, 15/16...2
– Spermathecal pores in five intersegmental furrows 12/13, 13/14, 14/15, 15/16, 16/17 7

2 Clitellum extended on less than 20 segments 3
– Clitellum extended on 20 or more segments 4

3 Clitellum on 10–23; tubercula pubertatis on 19–24 .... *decipiens* Michelsen
– Clitellum on 12–28; tubercula pubertatis on 18–23 .... *microchaetus* (Rapp)

4 Clitellum commences on segment 10 5
– Clitellum commences posterior to 10 6

5 Clitellum on 10–30; tubercula pubertatis dorsolateral, prominent on 16–20 with lateral extensions on 17–19; male pores in 17/18. Spermathecae and their pores occasionally in representatives of the same population also in furrow 16/17 .... *papillatus* Benham

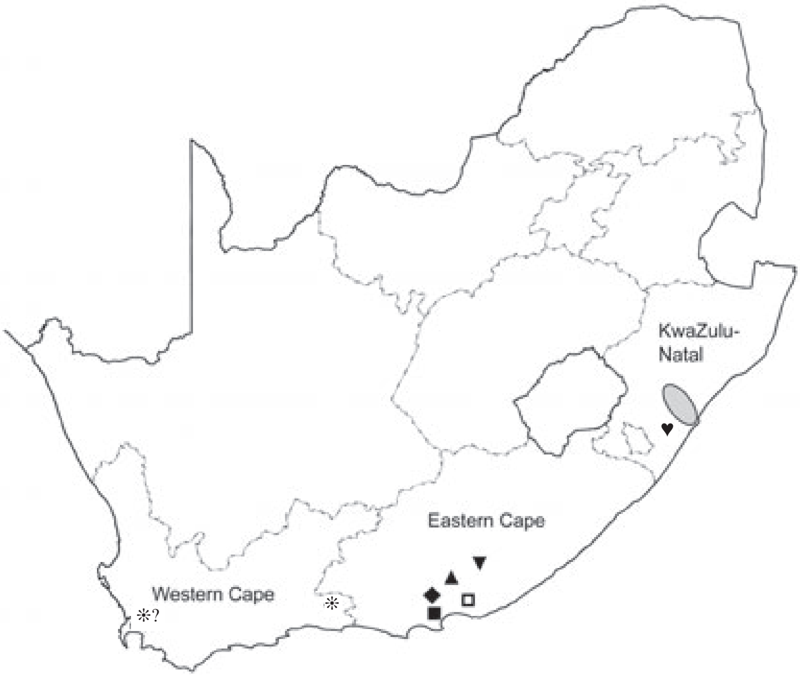

Fig. 1. Distribution of *Microchaetus* species: ✻? and ✻ for *microchaetus*; ■ for *braunsi*; □ for *decipiens*; ▲ for *klopperi*; ▼ for *stuckenbergi*; shaded area for *papillatus*; ◆ for *rappi*; ♥ for *vernoni*.

– Clitellum on 10–33, 34; tubercula pubertatis elongated on 18, 19–24; male pores in 19/20 .... *braunsi* Michaelsen

6 Clitellum on 11–31; tubercula pubertatis probably in area of 17–22 .... *rappi* Beddard

– Clitellum on 12–32; tubercula pubertatis as prominent ridges on 16–20. Occasionally, in representatives of the same population, posterior spermathecae and their pores in furrow 14/15 reduced .... *vernoni* Plisko

7 Clitellum on 10–32; tubercula pubertatis narrow ridges on 18–22; male pores in segment 20 .... *stuckenbergi* Plisko

– Clitellum on 11–32; tubercula pubertatis elongated on 22–29; male pores in 20 .... *klopperi* Plisko

Checklist of species retained in *Microchaetus*, with synonymy and distributions

Microchaetus braunsi Michaelsen, 1899

Microchaeta Braunsi: Michaelsen 1899*a*: 111; Reynolds & Cook 1976: 81.
Microchaetus braunsi: Michaelsen 1900: 451; Reynolds & Cook 1993: 23; Hartwich & Kilias 1989: 255; Plisko 1991*b*: 301; 1992: 340; 1993*b*: 235.
Microchaetus microchaetus var. *braunsi*: Michaelsen 1910: 161; 1913*a*: 538; 1918: 318; Reynolds & Cook 1976: 81.

The species is known from its type locality, Port Elizabeth, Eastern Cape, and Avontuur in the eastern part of Western Cape.

Microchaetus decipiens Michaelsen, 1899

Microchaeta decipiens: Michaelsen 1899*a*: 113.
Microchaeta rappi: Michaelsen 1891: 207 [*partim*].
Microchaetus decipiens: Michaelsen 1900: 452; Reynolds & Cook 1976: 93; Plisko 1991*b*: 301; 1992: 340; 1998: 294; 2003: 281.
Microchaetus microchaetus var. *decipiens*: Michaelsen 1910: 161; 1913*a*: 538; 1918: 318; Reynolds & Cook 1976: 93.

Known from the type locality, Grahamstown, Eastern Cape.

Microchaetus klopperi Plisko, 1991

Microchaetus klopperi: Plisko 1991*b*: 297; 2003: 281; Reynolds & Cook 1993: 16.

Known only from the type locality, Adelaide district, Eastern Cape.

Microchaetus microchaetus (Rapp, 1849)

Lumbricus microchaetus: Rapp 1849: 142; Perrier 1881: 239; Benham 1886*a*: 418; Reynolds & Cook 1976: 136.
Microchaetus microchaetus: Michaelsen 1900: 451 [*partim*]; Brinkhurst & Jamieson 1971: 739; Plisko 1991*b*: 300; 1992: 340; 1998: 252; 1999: 271 [redescription and taxonomic validation]; 2003: 281.
Anteus microchaetus: Perrier 1872: 49.
Anteus gigas: Horst 1891: 77.
Microchaeta microchaetus: Perrier 1881: 239 [invalid emendation of *Microchaetus*].
Lumbricus microchaeta: Beddard 1884: 570; 1886*a*: 63 [invalid emendation of *microchaetus*].
Microchaeta? *microchaeta*?: Vaillant 1890: 185.
Antaeus microchaetus: Vaillant 1890: 185 [invalid emendation of *Anteus*]; Reynolds & Cook 1976: 136.
Rappia? *microchaeta*: Vaillant 1890: 186; Reynolds & Cook 1976: 60.
Microchaeta rappi: Beddard 1895: 669.
Microchaetus microchaetus f. *typica*: Michaelsen 1910: 158; 1918: 317.
Microchaetus microchaetus var. *typica*: Michaelsen 1913*a*: 537.
Microchaetus microhaetus [*lapsus*]: Pickford 1975: 23.

The collection site was merely cited by Rapp as '*vom Cap*'; This caused disputes (Beddard 1884, 1886*a*, *b*; Michaelsen 1910; Plisko 1991*b*, 1999) as to whether the type locality was situated in the eastern district of Western Cape, or a southern part of Eastern Cape. Beddard (1886*b*) and Michaelsen (1899*a*, 1910), commenting on the identity of *rappi*, proposed synonymising it with *microchaetus*, and suggested an occurrence of both species also on the Cape Peninsula. However, records of *braunsi*, *decipiens* and *rappi* from Port Elizabeth, Grahamstown and Avontuur, suggest that *microchaetus* possibly was found originally in the eastern part of Western Cape or in a southern area of Eastern Cape.

Microchaetus papillatus Benham, 1892

Microchaeta papillata: Benham 1892: 141; Beddard 1895: 672.
Microchaetus papillatus: Michaelsen 1900: 450; 1907: 5; 1918: 320; Pickford 1975: 23; Reynolds & Cook 1976: 150; Plisko 1992: 345; 1993*b*: 235; 1998: 281; 2003: 281.
Microchaetus papillatus f. *typicus*: Michaelsen 1913*c*: 426.

The species is known from numerous sites between Durban and Pietermaritzburg, including both cities, in KwaZulu-Natal.

Microchaetus rappi Beddard, 1886

Microchaeta rappi: Beddard, 1886*b*: 63; Horst 1891: 77; Beddard 1895: 669; Plisko 1999: 273.
Microchaeta Rappii [invalid emendation of *rappi*]: Beddard 1886*b*: 306; 1895: 669; Coles 1981: 276.
Microchaeta Rappi: Rosa 1891: 380; Benham 1886*b*: 87.
Antaeus microchaeta [*partim*]: Vaillant 1890: 185 [invalid emendation of *Anteus*].
Microchaeta? *microchaeta* [*partim*]: Vaillant 1890: 186; Reynolds & Cook 1976: 60.
Microchaetus microchaetus [*partim*]: Michaelsen 1900: 451.
Microchaetus microchaetus var. *typica* [*partim*]: Michaelsen 1900: 451.

The type locality suggested to be 'Breakwater, Cape Town' (Beddard 1886*b*) is probably erroneous, and should be Grahamstown, Eastern Cape.

Microchaetus stuckenbergi Plisko, 1991

Microchaetus stuckenbergi: Plisko 1991*b*: 294; Reynolds & Cook 1993: 21; Plisko 2003: 281.

This species is known only from its type locality in Stutterheim district, Eastern Cape.

Microchaetus vernoni Plisko, 1992

Microchaetus vernoni: Plisko 1992: 349; Reynolds & Cook 1993: 22; Plisko 1998: 292; 2003: 292.

The species is known from numerous sites in Vernon Crookes Nature Reserve, KwaZulu-Natal.

Genus *Geogenia* Kinberg, 1867, **stat. rev.**

Geogenia: Kinberg 1867: 97; Perrier 1886: 876; Reynolds & Cook 1976: 52; 1993: 22; Pickford 1975: 23; Brinkhurst & Jamieson 1971: 739.
Microchaeta [*partim*]: Rosa 1891: 382; 1898: 1; Beddard 1895: 675.
Geogenia (*Microchaeta* ?): Michaelsen 1899*b*: 428.
Geogenia (*Microchaetus* ?): Michaelsen 1891: 38; 1899*b*: 428; 1900: 462.
Microchaetus: Michaelsen 1899*b*: 428 [redescription of *natalensis*]; [*partim*]: 1900: 448; 1908: 40; 1913*a*: 545; 1913*b*: 61; 1913*c*: 422; 1918: 331; Brook & Dick 1935: 237 [synonyms for *pentheri*]; Brinkhurst & Jamieson 1971: 739; Pickford 1975: 23 [*partim*]; Reynolds 1993: 6; Hodgson & Jamieson 1992: 112 [for *pentheri*]; Plisko 1995: 283; [*partim*]: 1991*a*: 279; 1992: 338; 1993*b*: 222; 1998: 250; 2002: 205; 2003: 281; 2005: 105; 2006: 34.

Type species: *Geogenia natalensis* Kinberg, 1867, by monotypy.

Diagnosis: Testes and male funnels in holandric arrangement. Excretory system holonephric, with nephridial holoic bladders V-shaped. One oesophageal gizzard in segment 7. Dorsal blood vessel double in 4–9, being partly or fully separated when crossing segments, but simple when crossing septa and posterior to septum 9/10; in segment 8 broadly parted, in 9 enlarged, constituting 'cordiform' organ. Calciferous glands not stalked, paired or encircling oesophagous, although always with dorsal or ventral vestigial grooves; in one or two segments. Spermathecae and spermathecal pores in pre-testis or testis segments, or post-testicular. If only pre-testicular or post-testicular, pores occur in less than four furrows. If in more than four furrows, pores occur anterior to testis segments, in testis and post-testicular intersegmental furrows. Seminal vesicles two pairs; rarely only one anterior pair. Two, three or four anterior septa (4/5–8/9) variably thickened. Body length of most species between 40–300 mm; some extending to 400 mm, one species reaching 800 mm. Number of segments approx. 100–500.

Comments: Although species of this resurrected genus are quite diverse, they share important features: V-shaped holoic bladders, dorsal blood vessel double in certain anterior segments, and gizzard in segment 7. They differ from *Microchaetus* (*s. str.*) in the lower number and position of post-testicular furrows in which spermathecal pores occur (if there are more furrows with spermathecal pores, some of them occur pre-testicularly), in variably thickened certain septa, in smaller body size, and lower number of segments. From the species of *Kazimierzus*, they differ in the shape of holonephric bladders, and dorsal blood vessel being double in anterior segments.

Thirteen species have all spermathecal pores in post-testicular furrows: *pondoana* (12/13); *zaloumisi* (13/14); *montana*, *parva*, *pentheri*, *rita*, *rivus*, *tuberosa* (12/13, 13/14); *herberti*, *idechorita*, *natalensis* (13/14, 14/15); *madida* (11/12, 12/13, 13/14); *ambita* (12/13,13/14,14/15). All pores located only in pre-testicular furrows occur in *distasmosa* and *quera* (8/9, 9/10), but in *namaensis* (9/10, 10/11, 11/12) only anterior pores occur in pre-testicular furrow, two others are in immediately post-testis furrows. In *caementerii*, *tegwana* and *gripha* (11/12, 12/13) the anterior pores occur in the furrow immediately posterior to second pair of testes. It is noteworthy that presence of spermathecal pores in 11/12, 12/13 is observed in the majority of proandric species, with testes and male funnels occurring only in segment 10. In *gripha* and *tegwana*, proandric reduction of the posterior pair of seminal vesicles is observed, and partial reduction of the posterior pair of vas deferens is noted in *tegwana*.

Two species, *benhami* and *mkuzi*, differ from their congeners in having spermathecal pores in six pre-testicular, testicular and post-testicular furrows, and in extended clitellum and tubercula pubertatis. Their geographical distribution is also exceptional (Fig. 2); *benhami* is known from cultivated lands in the area of Stellenbosch, Western Cape (Michaelsen 1913*a*, *b*; Pickford 1975, and new material housed in the Natal Museum), whereas *mkuzi* occurs in natural environments in northern KwaZulu-Natal (Plisko 1992, 1998, 2003).

The species *ambita*, *caementerii*, *distasmosa*, *gripha*, *herberti*, *idechorita*, *quera*, *tegwana*, *tuberosa* and *zaloumisi* occur in limited areas in KwaZulu-Natal. *G. natalensis* occurs widely in KwaZulu-Natal, Mpumalanga, Limpopo and neighbouring Swaziland. *G. parva* is known from numerous sites in KwaZulu-Natal and Mpumalanga; *pondoanus* occurs widely in Pondoland and neighbouring areas. Species *madidus*, *montana*, *pentheri*, *ritae* and *riva* are known only from Eastern Cape. *G. namaensis* was reported once from Northern Cape (Namaqualand).

Key to the species of *Geogenia* Kinberg

1 All spermathecal pores in intersegmental furrows posterior to testis segments ... 2
– Not so ... 17

2 Spermathecal pores in one intersegmental furrow ... 3
– Spermathecal pores in more than one furrow ... 4

3 Spermathecal pores in 12/13; clitellum on 12–20, 21; tubercula pubertatis on 16–17, 18. Moderate to large, reaching 350 mm ... *pondoana* (Michaelsen), **comb. n.**
– Spermathecal pores in 13/14; clitellum on 13–20; tubercula pubertatis on 16–18. Not exceeding 120 mm ... *zaloumisi* (Plisko), **comb. n.**

4 Spermathecal pores in two furrows ... 5
– Spermathecal pores in more than two furrows ... 16

5 Spermathecal pores in 11/12 and 12/13, or in 12/13 and 13/14 ... 6
– Spermathecal pores in 13/14 and 14/15 ... 14

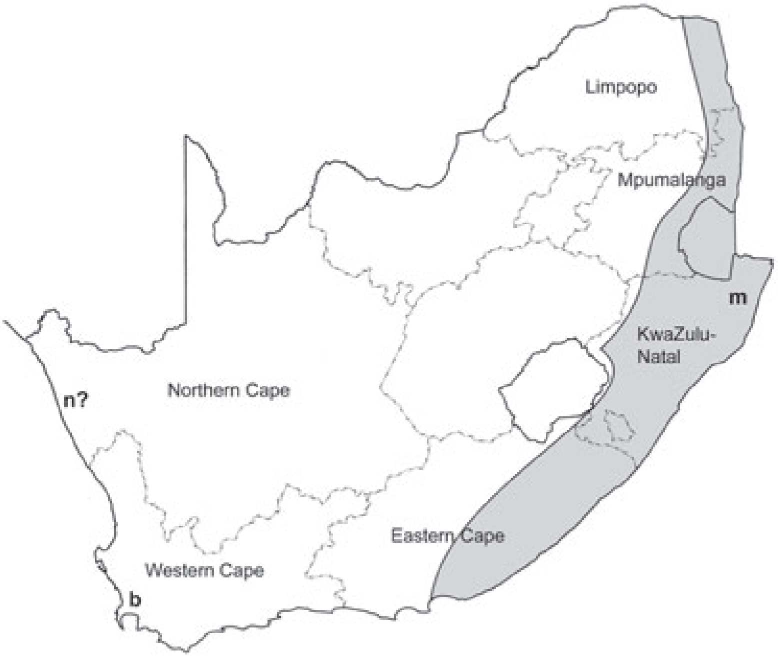

Fig. 2. Distribution of *Geogenia* species indicated as shaded area, with **m** for *mkuzi*; **b** for *benhami*; **n?** for *namaensis*.

6 Spermathecal pores in 11/12 and 12/13 7
– Spermathecal pores in 12/13 and 13/14 9

7 Two pairs of seminal vesicles similar size, confined to 10 and 11 respectively. Vasa deferentia double, entering male pores in 17 or 17/18; clitellum on 10–24; tubercula pubertatis prominent, segmented, rimmed, on 16–20; septa 7/8 and 8/9 thickened. Mature individuals large, reaching 800 mm .... *caementerii* (Michaelsen), **comb. n.**
– One pair of seminal vesicle commencing at 10/11, extending posteriorly 8

8 Seminal vesicles extending to 11; posterior pair of male funnels much smaller than anterior; vasa deferentia initially double, enter male pores in 17/18 as simple tube; clitellum on 1/n12–23; tubercula pubertatis as segmented bands on 17–20; typhlosole commences at beginning of intestine in 13. Septa 7/8 and 8/9 thickened. Mature individuals large, 260–350 mm .... *tegwana* (Plisko), **comb. n.**
– Seminal vesicles extending to12; male funnels similar size; vasa deferentia paired, and double when entering male pores in 17/18; clitellum on 13–25; tubercula pubertatis rounded at corners on 17–1/n20; typhlosole commences in 19. Mature individuals small, not exceeding 70 mm .... *gripha* (Plisko), **comb. n.**

9 Typhlosole commences at beginning of intestine 10
– Typhlosole commences posterior to commencement of intestine 11

10 Two septa 7/8, 8/9 thickened moderately; male pores in 18/19; clitellum on 11, 12–22; tubercula pubertatis as oval ridges on 17–20, n21. Medium sized, approx. 120 mm .... *ritae* (Plisko), **comb. n.**

– Four septa 4/5, 5/6, 7/8, 8/9 variably thickened; male pores in 17/18; clitellum on 11, 12–22, 23; tubercula pubertatis sub-rectangular, with shallow furrow at 17/18. Mature individuals medium to large, extending to 400 mm .... *pentheri* (Rosa), **comb. n.**

11 Typhlosole commences in segment 15. Three septa 4/5, 7/8, 8/9 variably thickened; male pores in 14/15; clitellum on 12–20, n21; tubercula pubertatis sub-rectangular ridges on 16–18. Moderate, approx. 120 mm .... *montana* (Plisko), **comb. n.**

– Typhlosole commences behind segment 15 12

12 Typhlosole commences in 17 or 18; septa 4/5, 7/8, 8/9 moderately thickened. Clitellum on 12, 13–22, 13; tubercula pubertatis as oblong narrow swellings on 1/n15, 16–19, 20. Mature individuals small to moderate, not exceeding 100 mm .... *riva* (Plisko), **comb. n.**

– Typhlosole commences in 19; septa 4/5, 7/8, 8/9 variably, moderately thickened 13

13 Paired seminal vesicle in 10 and 11 respectively, dorsolaterally; clitellum on 12–21; tubercula pubertatis longitudinal ridges, on 14, 15–17, 18. Mature individuals small, not exceeding 70 mm .... *parva* (Michaelsen), **comb. n.**

– Seminal vesicles commencing at septa 10/11 and 11/12 extend dorsolaterally as simple sacs to segments 10 and 11 respectively; clitellum on 13–22; tubercula pubertatis as irregular elongated swellings, segmented, rimmed on 1/n14, 15–18. Moderate in size, extending to 120 mm .... *tuberosa* (Plisko), **comb. n.**

14 Only anterior pair of seminal vesicles commencing at septum 10/11, extending to segment 11, and terminating at 11/12; spermathecae paired; septa 7/8 and 8/9 thickened moderately. Typhlosole commences with intestine in 13; male pores in 18; clitellum on 12–21; tubercula pubertatis elongated, glandular, segmented. Mature individuals approx. 115 mm .... *idechorita* (Plisko), **comb. n.**

– Two pairs of seminal vesicles in 10 and 11 respectively; spermathecae multiple; septa 4/5, 7/8, 8/9 well thickened 15

15 Clitellum on 13–22; tubercula pubertatis as glandular strips, with large genital fields; male pores in 16/17. Mature individuals 100–170 mm long .... *natalensis* Kinberg

– Clitellum on 13–24, 1/n25; tubercula pubertatis as prominent glandular ridges on 1/n15–1/n19; genital fields wide, rimmed; male pores in 15/16. Mature individuals large, reaching 400 mm .... *herberti* (Plisko), **comb. n.**

16 Spermathecal pores in 11/12, 12/13, 13,14; clitellum on 12–24; tubercula pubertatis oval, glandular ridges, on 15–21; male pores in 18/19; septa 4/5, 5/6, 7/8, 8/9 and 9/10 variably thickened; calciferous glands paired in 9. Moderate to large, 100–250 mm .... *madida* (Plisko), **comb. n.**

– Spermathecal pores in 12/13, 13/14, 14/15; clitellum on 12–25; tubercula pubertatis sub-rectangular, rimmed on 1/n15–1/n20; male pores in 16/17; septa 4/5, 5/6, 7/8, 8/9 moderately and variably thickened; calciferous glands encircling oesophagous in 9. Extending to 300 mm .... *ambita* (Plisko), **comb. n.**

17 All spermathecal pores anterior to testis segments, in intersegmental furrows 8/9 and 9/10 18

– Some of spermathecal pores anterior to testis segments and in furrows of testis segments, or in pre-testis, testis and post-testis intersegmental furrows 19

18 Clitellum on 11–27; tubercula pubertatis as elongated strips on 19–24; septa 5/6 and 6/7 most thickened, 7/8 and 8/9 thickened little; typhlosole commences in 17; glandular papillae on segments 7–10, 25–27, small globular blisters on 11–18. Moderate, 100–150 mm .... *quaera* (Plisko), **comb. n.**

– Clitellum on 1/n11, 12–28, 29; tubercula pubertatis as glandular tubercles on 18, 19–27, 28; septa 4/5, 6/7, 7/8, 8/9 thickened variably; typhlosole commences in 20; glandular papillae variable in size and shape, on segments 5–7 and 11–18. Small, not exceeding 100 mm .... *distasmosa* (Plisko), **comb. n.**

19 Spermathecal pores in 9/10, 10/11, 11/12. Clitellum on 10–26; tubercula pubertatis as flattened fields, rimmed, on 17–23; five septa 4/5, 5/6, 6/7, 7/8 and 8/9 variably thickened; calciferous glands encircling oesophagous in 9–10. Moderate, approx. 100 mm .... *namaensis* (Michaelsen), **comb. n.**

– Spermathecal pores in 10/11–15/16. Larger 20

20 Spermathecae numerous in segment; clitellum on 10–28; tubercula pubertatis on 17–27; septa 4/5, 5/6, 6/7 well thickened. Large, reaching over 300 mm .... *benhami* (Rosa), **comb. n.**

– Spermathecae paired; clitellum on 11–28; tubercula pubertatis on 19–27; septa 4/5, 5/6, 6/7, 7/8, 8/9 variably thickened. Large, exceeding 250 mm .... *mkuzi* (Plisko), **comb. n.**

Checklist of *Geogenia* species, with synonymy and distributions

Geogenia ambita (Plisko, 1998), **comb. n.**

Microchaetus ambitus: Plisko 1998: 258; 2003: 281.

Only known from Vernon Crookes Nature Reserve, KwaZulu-Natal.

Geogenia benhami (Rosa, 1891), **comb. n.**

Microchaeta Benhami: Rosa 1891: 382.
Microchaeta benhami: Beddard 1895: 673.
Microchaetus benhami: Michaelsen 1891: 382; 1900: 451; 1913*a*: 538; 1913*b*: 61; 1918: 316; Pickford 1975: 2; Reynolds & Cook 1976: 77; Plisko 1992: 339; 1993*b*: 235; 1995*b*: 46.

This species is known from numerous sites, all in Stellenbosch district, Western Cape. Described from an unknown locality by Rosa (1891), reported by Michaelsen (1913*a*, *b*) and Pickford (1975) from garden soil in Stellenbosch. Two recently collected adult specimens (NMSA/Olig.03925), and verbal information from Frana Fourie (University of Stellenbosch), confirm a large population of this species near a local dam in Papegaaiberg close to Stellenbosch. It is noteworthy that *benhami* is morphologically close to *mkuzi* (Plisko 1992), which occurs in natural sites in northern KwaZulu-Natal (Plisko 1992, 1998, 2003).

Geogenia caementerii (Michaelsen, 1913), **comb. n.**

Microchaetus papillatus var. *caementerii*: Michaelsen 1913*c*: 429; Reynolds & Cook 1976: 83.
Microchaetus caementerii: Michaelsen 1918: 321; Pickford 1975: 23; Plisko 1991*a*: 282 [redescription of the paratype housed in the Natal Museum]; 1992: 340; 1995*b*: 49; 1998: 260; 2003: 288; Reynolds & Cook 1993: 23.

The species was known from a few localities in the Pietermaritzburg district, but may now be extinct. Midlands of KwaZulu-Natal.

Geogenia distasmosa (Plisko, 2003), **comb. n.**

Microchaetus distasmosus: Plisko 2003: 282.

Known from a few sites along the Mfolozi River, KwaZuluNatal.

Geogenia gripha (Plisko, 2002), **comb. n.**

Microchaetus griphus: Plisko 2002: 205; 2003: 281.

This interesting species has been found only at its type locality in Richards Bay, KwaZulu-Natal.

Geogenia herberti (Plisko, 2002), **comb. n.**

Microchaetus herberti: Plisko 2002: 208; 2003: 281.

The species is known from a few closely situated sites at Marble Delta, southern KwaZulu-Natal.

Geogenia idechorita (Plisko, 2003), **comb. n.**

Microchaetus idechoritus: Plisko 2003: 284.

Known only from the indigenous Ngele Forest, southern KwaZulu-Natal.

Geogenia madida (Plisko, 1993), **comb. n.**

Microchaetus madidus: Plisko 1993*b*: 223.

Recorded only from its type locality in the Hogsback mountains, Eastern Cape.

Geogenia mkuzi (Plisko, 1992), **comb. n.**

Microchaetus mkuzi: Plisko 1992: 341; 1998: 273; 2003: 281.

Known from numerous sites in Itala and Mkuzi game reserves. Collected also outside the reserves, on the banks of the Mkuzi River. All sites in northern KwaZulu-Natal.

Geogenia montana (Plisko, 1993), **comb. n.**

Microchaetus montanus: Plisko 1993*b*: 226.

Known only from the type locality in a montane area near Barkley Pass, Eastern Cape.

Geogenia namaensis (Michaelsen, 1908), **comb. n.**

Microchaetus namaensis: Michaelsen 1908: 40; 1913*a*: 541; 1918: 319; Pickford 1975: 23; Reynolds & Cook 1976: 143; Hartwich & Kilias 1989: 276; Plisko 1992: 339; 1995*b*: 48 [redescription].

This species is known only from the type locality. According to a record given by Michaelsen (1908), and data on the label inserted in the tube containing type specimens (Plisko 1995*b*), the material was collected in the area of Komaggas in Namaqualand, Northern Cape. However, the relationships of this species suggest the possibility of erroneous labelling.

Geogenia natalensis Kinberg, 1867

Geogenia natalensis: Kinberg 1867: 100; Perrier 1886: 876; Michaelsen 1899*b*: 428; 1900: 462; Reynolds & Cook 1976: 143.

Geogenia (*Microchaeta* ?) *natalensis*: Michaelsen 1899*b*: 428 [redescription].

Microchaetus natalensis: Michaelsen 1913*c*: 422; 1918: 324; Brinkhurst & Jamieson 1971: 739; Pickford 1975: 23; Reynolds & Cook 1976: 143; Plisko 1991*a*: 287; 1992: 345; 1993*b*: 235; 1995*a*: 283; 1998: 273; 2003: 289; Reynolds 1993: 6.

This species is the most widely distributed microchaetid in South Africa. It occurs mainly in north-eastern parts of the country. Records are from a broad range of sites in KwaZulu-Natal, Mpumalanga and Limpopo provinces, and Kruger National Park. Recorded also from Swaziland (Reynolds 1993). Its occurrence is expected in Mozambique and possibly also in Zimbabwe.

Geogenia parva (Michaelsen, 1913), **comb. n.**

Microchaetus parvus: Michaelsen 1913*c*: 445; 1918: 331; Reynolds & Cook 1976: 152; Plisko 1991*a*: 279 [redescription]; 1992: 439; 1998: 282; 2003: 290.

Recorded from numerous sites in natural and agricultural environments in KwaZulu-Natal and Mpumalanga.

Geogenia pentheri (Rosa, 1898), **comb. n.**

Microchaeta pentheri: Rosa 1898: 1.
Microchaetus pentheri: Michaelsen 1900: 452; Broock & Dick 1935: 239; Brinkhurst & Jamieson 1971: 58; Pickford 1975: 23; Reynolds & Cook 1976: 154; Plisko 1992: 340; 1993*b*: 232 [redescription, and recorded synonyms]; 2003: 281; Hodgson & Jamieson 1992: 112 [spermatogenesis studied; apomorphy in the acrosome noted].
Microchaetus pentheri var. *typica*: Michaelsen 1913*a*: 540.
Microchaetus pentheri f. *typica*: Michaelsen 1918: 323.
Microchaetus pentheri var. *elizabethae*: Michaelsen 1899: 115; 1900: 453; 1913*a*: 541; 1918: 323; Reynolds & Cook 1976: 98.
Microchaeta pentheri var. *saxatilis*: Rosa 1898: 3; Michaelsen 1900: 453; 1913*a*: 541; 1918: 323.
Microchaetus pentheri: Broock & Dick 1935: 237.
Microchaetus sandersi: Broock & Dick 1935: 238.

Found at many sites in the districts of Port Elizabeth, Grahamstown, Adelaide and Hogsback, all in Eastern Cape.

Geogenia pondoana (Michaelsen, 1913), **comb. n.**

Microchaetus pondoanus var. *typica*: Michaelsen 1913*a*: 542.
Microchaetus pondoanus var. *minor*: Michaelsen 1913*a*: 547.
Microchaetus pondoanus: Pickford 1975: 23; Reynolds & Cook 1976: 137; 1993: 27; Plisko 1992: 339; 1998: 288; 2002: 210; 2003: 291.

Recorded from many sites, occurring in indigenous forests of Pondoland, Eastern Cape, and in KwaZulu-Natal.

Geogenia quera (Plisko, 2003), **comb. n.**

Microchaetus querus: Plisko 2003: 286.

This species is known only from its type locality in Hluhluwe Game Reserve, northern KwaZulu-Natal.

Geogenia ritae (Plisko, 1993), **comb. n.**

Microchaetus ritae: Plisko 1993: 225; 2003: 281.

Known only from the type locality in Adelaide district, Eastern Cape.

Geogenia riva (Plisko, 1993), **comb. n.**

Microchaetus rivus: Plisko 1993: 229; 2003: 281.

Known from the type locality near Umtata, Eastern Cape.

Geogenia tegwana (Plisko, 2005), **comb. n.**

Microchaetus tegwanus: Plisko 2005: 105.

Recently discovered in the Underberg area near the foothills of the Drakensberg, KwaZulu-Natal.

Geogenia tuberosa (Plisko, 1998), **comb. n.**

Microchaetus tuberosus: Plisko 1998: 290; 2003: 291.

Known from a broad range of sites in coastal lowlands of southern KwaZulu-Natal.

Geogenia zaloumisi (Plisko, 1992), **comb. n.**

Microchaetus zaloumisi: Plisko 1992: 352; 1998: 293; 2003: 281; Reynolds & Cook 1993: 22.

Found only at the type locality and in its close proximity, in Vernon Crookes Nature Reserve, southern KwaZulu-Natal.

Kazimierzus gen. n.

Microchaetus: Michaelsen 1908: 38 [for *rosai*]; 1913*a*: 535 and 1913*b*: 60 [for *peringueyi*]; Pickford 1975: 23 [for *crousi*, *franciscus*, *guntheri*, *ljungstroemi*, *pearsonianus*]; Reynolds & Cook 1976: 56 [*partim*]; Plisko 1992: 338; 1993*b*: 230 [*partim*]; 1998: 250 [for *alipentus*, *circulatus*, *crousi*, *davidi*, *hamerae*, *imitatus*, *metandrus*, *obscurus*, *occidualis*, *occiduus*, *pauli*, *pentus*, *senarius*]; 2002: 211 [for *sophieae*].

Proandricus: Plisko 1996*b*: 305 [for *sirgeli*].

Etymology: Named for Dr Kazimierz Plisko in recognition of his friendly support during many years of my study on earthworms. Gender masculine.

Type species *Microchaetus hamerae* Plisko, 1998, by present designation.

Diagnosis: Testes and male funnels in holandric or metandric arrangement. One oesophageal gizzard in segment 7. Excretory system holonephric, with nephridial holoic bladders J-shaped. Dorsal blood vessel simple through whole body. Calciferous glands not staked, in one or two segments 9, 10, 11, or 10–11. Glands encircling oesophagus with vestigial, medial and dorsal grooves, or dorsoventral, paired, with obvious medial and dorsal grooves. Vasa deferentia paired; one pair in metandric, two pairs in holandic species. Seminal vesicles one or two pairs, confined to one or two segments, or extended behind segment 12, sometimes as far as to segment 28. Spermathecae and their pores located behind testis segments. Spermathecal ampullae globular with variably shaped ducts. Some of preclitellar septa 4/5–9/10 variably thickened. Body length 60–330 mm. Segment number 200–500.

Comments: Twenty-one species, occurring in the western and south-western coastal Atlantic area of South Africa, constitute this genus. It is characterised by the following features: constant presence of simple dorsal blood vessel along the whole body, and J-shaped nephridial holoic bladders; occasional metandric male gonad condition, metandric or proandric reduction of a pair of seminal vesicles, sporadically extended backwards, and septum 9/10 being occasionally thickened. The species *circulatus*, *davidi*, *rosai* and *sophieae* are known from the northern part of Namaqualand (Fig. 3). The species *alipentus*, *guntheri*, *hamerae*, *imitatus*, *ljungstroemi*, *metandrus*, *obscurus*, *occidualis*, *occiduus*, *pauli*, *pentus*, *peringueyi* and *senarius* are recorded from Western Cape, extending inland to Citrusdal, Porterville, Ceres, Tulbagh, and to Swellendam (*crousi*, *franciscu*s), as illustrated by Plisko (1998). *K. pearsonianus* is known from the Cape Peninsula.

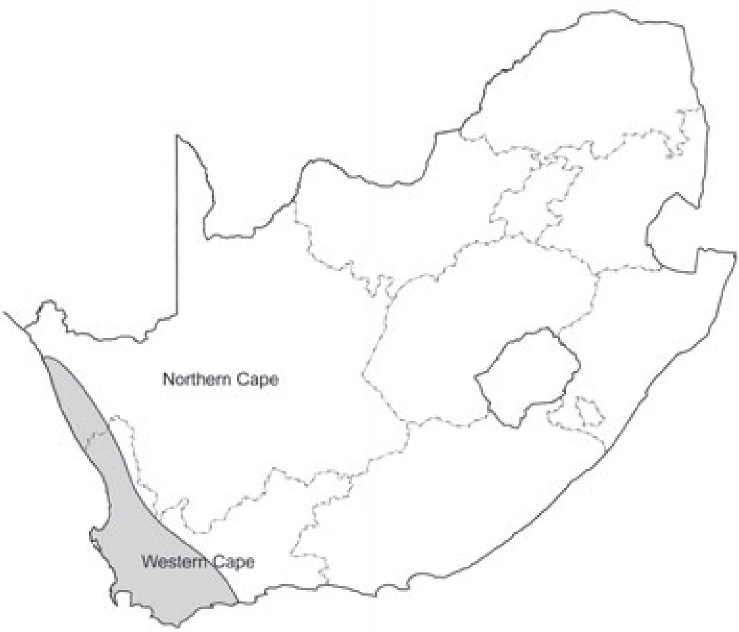

Fig. 3. Distribution of *Kazimierzus* species indicated as shaded area.

It is noteworthy that a decrease of posterior male funnel size and their enclosure in seminal vesicles observed in *sirgeli*, resulted in misclassification of this species in the genus *Proandricus*. Four pairs of spermathecae located in furrows 12/13, 13/14, 14/15, 15/16, dorsal blood vessel simple along the whole body, distinctively shaped seminal vesicles, and the distribution range of the species within a south-western part of Western Cape, raised some doubts (Plisko 1996*b*, 2000). The present review shows that this species belongs to *Kazimierzus*.

Key to the species of *Kazimierzus* gen. n.

1 Testes and male funnels in metandric arrangement (in segment 11). Vasa deferentia as single pair commence in 11, extending to 18 enter male pores in 18/19; seminal vesicles one pair, commencing at 11/12 extend posterior to 24; spermathecal pores in three intersegmental furrows (13/14, 14/15, 15/16); spermathecae one pair per segment; calciferous glands paired, separated dorsally and medially; six septa 7/8–9/10 variably thickened; clitellum on 13–22; tubercula pubertatis on 17–20 .... *metandrus* (Plisko), **comb. n.**

– Testes and male pores in holandric arrangement (in segments 10 and 11) 2

2 Two pairs of seminal vesicles present 3

– One pair of seminal vesicles reduced 16

3 Seminal vesicles not extending behind segment 12 4

– Seminal vesicles extending behind segment 12 7

4 Spermathecal pores in three furrows (13/14, 14/15, 15/16). Four septa thickened variably (4/5, 5/6, 6/7 very much, 7/8 less); spermathecae multiple; calciferous

glands paired, in 10–11; clitellum on 13–26; tubercula pubertatis on 17–21 .... *franciscus* (Pickford), **comb. n.**

– Spermathecal pores in four furrows 5

5 Spermathecal pores in 13/14–16/17; three septa 4/5, 5/6, 6/7 strongly thickened. Spermathecae 1–2 pairs per segment; calciferous glands encircling oesophagous, in 10; clitellum on 14–23; tubercula pubertatis on 16–21 .... *crousi* (Pickford), **comb. n.**

– Spermathecal pores in 12/13–15/16; six septa (4/5–9/10) variably thickened 6

6 Spermathecae one pair per segment; calciferous glands encircling oesophagous, in 10; clitellum on 13–23; tubercula pubertatis on 17–20 .... *circulatus* (Plisko), **comb. n.**

– Spermathecae multiple; calciferous glands paired, in 10; clitellum on 12–24, 25; tubercula pubertatis on 18–20, 21 .... *davidi* (Plisko), **comb. n.**

7 Spermathecal pores in three furrows (13/14, 14/15, 15/16) 8

– Spermathecal pores in more than three furrows 12

8 Posterior pair of seminal vesicles extending through two segment (13–14) 9

– Posterior pair of seminal vesicles extending variably, through more than two segments 10

9 Three septa (4/5, 5/6, 6/7) strongly thickened; spermathecae multiple; tubercula pubertatis on 18–28; calciferous glands encircling oesophagous in 10–11 .... *guntheri* (Pickford), **comb. n.**

– Six septa (4/5–9/10) variably thickened; spermathecae multiple; tubercula pubertatis on 17–18; calciferous glands dorsolateral. Clitellum on 13–22 .... *occidualis* (Plisko), **comb. n.**

10 Three septa (4/5, 5/6, 6/7) thickened moderately. Posterior pair of seminal vesicles extending to 23, 24; spermathecae multiple; clitellum on 12, 13–22, 23; tubercula pubertatis on 17–20 .... *occiduus* (Plisko), **comb. n.**

– More than three septa thickened 11

11 Five septa (4/5, 5/6, 7/8, 7/9, 9/10) variably thickened; seminal vesicles extending backwards reaching segment 20; spermathecae 1–2 pairs per segment; tubercula pubertatis on 17–19, 20. Clitellum on 13–22 .... *sophieae* (Plisko), **comb. n.**

– Six septa (4/5–9/10) variably thickened; seminal vesicles extending backward to segment 23; spermathecae one pair per segment; tubercula pubertatis on 17–20 .... *ljungstroemi* (Pickford), **comb. n.**

12 Spermathecal pores in four furrows (12/13–15/16) 13

– Spermathecal pores in more than four furrows 14

13 Seminal vesicles variable in size, shape and length, extending variably at both sides, reaching segments 23, 24; spermathecae one pair per segment; calciferous glands paired, in 10 and partly in 11; clitellum on 12–23, 24; tubercula pubertatis on 16–20 .... *hamerae* (Plisko), **comb. n.**

– Posterior pair of seminal vesicles much larger than anterior, extending to segment 28; spermathecae one pair per segment; calciferous glands encircling oesophagous in 10–11; clitellum on 15–24; tubercula pubertatis on 17–20 .... *rosai* (Michaelsen), **comb. n.**

14 Spermathecal pores in six furrows (11/12–16/17). Septa 4/5, 5/6 thickened moderately, 7/8, 8/9 firm, muscular; posterior pair of seminal vesicles extending to 15; clitellum on 12–26; tubercula pubertatis on 17–24 .... *senarius* (Plisko), **comb. n.**

– Spermathecal pores in five furrows 15

15 Spermathecal pores in 11/12–15/16; septa 4/5, 5/6, 7/8, 8/9 thickened, muscular; posterior pair of seminal vesicles extending to segment 15; clitellum on 12–25; tubercula pubertatis on 17–23 .... *pentus* (Plisko), **comb. n.**

– Spermathecal pores in 12/13–16/17; septa 4/5, 5/6, 7/8, 8/9 thickened moderately, 6/7 and 9/10 firm, slightly thickened; posterior pair of seminal vesicles extending to 15; clitellum on 12–27, 28; tubercula pubertatis on 17–24 .... *obscurus* (Plisko), **comb. n.**

16 Anterior pair of seminal vesicles reduced 17

– Posterior pair of seminal vesicles reduced; anterior pair of seminal vesicles commences at 10/11 18

17 Posterior pair of well developed seminal vesicles commencing at 11/12 extending forwards and backwards though three to five segments; three septa (4/5, 5/6, 6/7) strongly thickened, septa 7/8, 8/9 thickened less than anterior; spermathecal pores in three intersegmental furrows (13/14–15/16); spermathecae multiple; calciferous glands encircling oesophagous in 10; clitellum on 11–28; tubercula pubertatis on 18–23 .... *pearsonianus* (Pickford), **comb. n.**

– Posterior pair of seminal vesicles confined to segment 12, enclosing posterior pair of male funnels; two septa (4/5, 5/6) moderately thickened, septa 7/8 and 8/9 thickened more than anterior; spermathecal pores in four intersegmental furrows (12/13–15/16); spermathecae one pair per segment; calciferous glands encircling oesophagous in 9; clitellum on 10–22; tubercula pubertatis on 17–20 .... *sirgeli* (Plisko), **comb. n.**

18 Spermathecal pores in five furrows 19

– Spermathecal pores in six furrows (11/12–16/17) 20

19 Spermathecal pores in intersegmental furrows 11/12–15/16; seminal vesicles slender, irregular tubes, enlarging gradually projecting through segments 11–13, 14; calciferous glands paired, in 10 with extension to 11, although not breaking septum 10/11; clitellum 12–25; tubercula pubertatis 17–23. Four septa (4/5, 5/6, 7/8, 8/9) thickened moderately, slightly muscular .... *alipentus* (Plisko), **comb. n.**

– Spermathecal pores in intersegmental furrows 12/13–16/17; seminal vesicles lobulated, extends through 11 to 12; calciferous glands encircling oesophagous in 10; clitellum 12–25; tubercula pubertatis 17–20 .... *peringuei* (Michaelsen), **comb. n.**

20 Four septa (4/5, 5/6, 7/8, 8/9) thickened firmly, muscular; seminal vesicles lobulated, variable in size, extending variably at each side, extending to 15 or 17; clitellum on 11–28; tubercula pubertatis 17–24 .... *pauli* (Plisko), **comb. n.**

– Five septa (4/5, 5/6, 7/8 8/9, 9/10) thickened slightly; seminal vesicles elongated, twisting forwards and backwards extending through 11–15; clitellum 12–26; tubercula pubertatis 17–24 .... *imitatus* (Plisko), **comb. n.**

Checklist of species of *Kazimierzus* gen. n., with synonymy and distributions

Kazimierzus alipentus (Plisko, 1998), **comb. n.**

Microchaetus alipentus: Plisko 1998: 255; 2003: 281.

This species is known only from the type locality in Citrusdal district, Western Cape.

Kazimierzus circulatus (Plisko, 1998), **comb. n.**

Microchaetus circulatus: Plisko 1998: 260; 2003: 281.

Known from the type locality in the Kamiesberg range, Northern Cape.

Kazimierzus crousi (Pickford, 1975), **comb. n.**

Microchaetus crousi: Pickford 1975: 42; Reynolds & Cook 1976: 91; Plisko 1992: 339; 1998: 252; 2003: 281.

Known from Swellendam district, Western Cape.

Kazimierzus davidi (Plisko, 1998), **comb. n.**

Microchaetus davidi: Plisko 1998: 263; 2003: 281.

Known from the type locality in the Kamiesberg range, Northern Cape.

Kazimierzus franciscus (Pickford, 1975), **comb. n.**

Microchaetus franciscus: Pickford 1975: 46; Reynolds & Cook 1976: 103; Plisko 1992: 339; 1993*b*: 230; 1998: 339; 2003: 281.

Recorded from few sites in Swellendam district, south-eastern part of Western Cape.

Kazimierzus guntheri (Pickford, 1975), **comb. n.**

Microchaetus guntheri: Pickford 1975: 37; Reynolds & Cook 1976: 110; Plisko 1992: 339; 1993*b*: 235; 1998: 252; 2003: 281.

Known from the type locality in White River valley, Western Cape.

Kazimierzus hamerae (Plisko, 1998), **comb. n.**

Microchaetus hamerae: Plisko 1998: 265; 2003: 281.

This species is known from numerous sites in Northern Cape and Western Cape.

Kazimierzus imitatus (Plisko, 1998), **comb. n.**

Microchaetus imitatus: Plisko 1998: 268; 2003: 281.

Known only from the type locality near Porterville, Western Cape.

Kazimierzus ljungstroemi (Pickford, 1975), **comb. n.**

Microchaetus ljungstroemi: Pickford 1975: 50; Reynolds & Cook 1976: 129; Plisko 1992: 339; 1993: 235; 1998: 270.

Known from the type locality in Tulbagh district, Western Cape.

Kazimierzus metandrus (Plisko, 1998), **comb. n.**

Microchaetus metandrus: Plisko 1998: 271; 2003: 281.

This interesting species has been recorded from numerous sites in the districts of Ceres and Porterville, Western Cape.

Kazimierzus obscurus (Plisko, 1998), **comb. n.**

Microchaetus obscurus: Plisko 1998: 275; 2003: 281.

Known from the type locality in Porterville district, Western Cape.

Kazimierzus occidualis (Plisko, 1998), **comb. n.**

Microchaetus occidualis: Plisko 1998: 277; 2003: 281.

Known from the type locality in Clanwilliam district, Western Cape.

Kazimierzus occiduus (Plisko, 1998), **comb. n.**

Microchaetus occiduus: Plisko 1998: 279; 2003: 281.

This species ranges quite widely in Western Cape, having been recorded from numerous sites in the districts of Vanrhynsdorp (Namaqualand), Ceres and Tulbagh.

Kazimierzus pauli (Plisko, 1998), **comb. n.**

Microchaetus pauli: Plisko 1998: 283; 2003: 281.

Known from the type locality, in Vanrhynsdorp district (Namaqualand), Western Cape.

Kazimierzus pearsonianus (Pickford, 1975), **comb. n.**

Microchaetus pearsonianus: Pickford 1975: 31; Reynolds & Cook 1976: 153; Plisko 1992: 339; 1993*b*: 235; 1998: 285; 2003: 281.

This species is known from the Cape Peninsula; recorded from a few sites in the Kirstenbosch Botanical Garden, Western Cape.

Kazimierzus pentus (Plisko, 1998), **comb. n.**

Microchaetus pentus: Plisko 1998: 286; 2003: 281.

Known from the type locality in Citrusdal district, Western Cape.

Kazimierzus peringueyi (Michaelsen, 1913), **comb. n.**

Microchaetus peringueyi: Michaelsen 1913*a*: 535; 1913*b*: 60; Pickford 1975: 23; Reynolds & Cook 1976: 155; Plisko 1992: 340; 1998: 294; 2003: 281.

Known from one specimen collected in Calvinia area (Bokkeveldberge), Northern Cape.

Kazimierzus rosai (Michaelsen, 1908), **comb. n.**

Microchaetus Rosai: Michaelsen 1908: 38.
Microchaetus rosae [*lapsus*]: Pickford 1975: 23.
Microchaetus rosai: Michaelsen 1918: 311; Reynolds & Cook 1976: 164; Hartwig & Kilias 1989: 283; Plisko 1992: 339; 1993*b*: 222; 1995*b*: 47 [redescription]; 1998: 293; 2003: 281.

Known from the type locality in Komaggas in northern Namaqualand, Northern Cape.

Kazimierzus senarius (Plisko, 1998), **comb. n.**

Microchaetus senarius: Plisko 1998: 289; 2003: 281.

Known from Porterville district, Western Cape.

Kazimierzus sirgeli (Plisko, 1996), **comb. n.**

Proandricus sirgeli: Plisko 1996*b*: 305; 2002: 184; 2003: 293.

Only the type specimen has been found in Hottentots-Holland Nature Reserve, south-eastern Western Cape.

Kazimierzus sophieae (Plisko, 2002), **comb. n.**

Microchaetus sophieae: Plisko 2002: 211; 2003: 281.

Known only from its type locality in Nieuwoudtville district, Northern Cape.

DISCUSSION

The results of the present study considerably improve understanding of microchaetid diversity and geographical distribution in South Africa. The genus *Microchaetus* (*s. l.*) in which many species had been described, is now shown to be composite, and is divided into three genera: *Microchaetus* (*s. str.*), *Geogenia* and the new genus *Kazimierzus*. Although holandry, holonephry and the gizzard location in segment 7 are common to all three genera, each genus has a distinctive suite of character states. *Microchaetus* is now restricted to a group of eight species, remarkable for their very large to gigantic sizes. It includes the first-described species *microchaetus*, as well as *rappi*, *papillatus*, *braunsi*, *decipiens*, *stuckenbergi*, *klopperi* and *vernoni*. *M. vernoni* is possibly the world's longest earthworm, as collected specimens have exceeded 2 meters in length and have more than 1200 segments. The distribution of this genus is noteworthy: six of the species occur in Eastern Cape Province; this is an area with unusual environmental features, being a transitional zone in rainfall seasonality, with topographic diversity and complex botanical biota. Many invertebrate taxa have distributions which reflect this transitional nature. Endemism of distinctive lineages often occurs in Eastern Cape, and the relationships of some of these endemic elements often are with taxa in Western Cape, or in the subtropical biomes of KwaZulu-Natal and adjacent territories lying between the eastern escarpment and Indian Ocean. Two *Microchaetus* species were found in KwaZulu-Natal. In view of the long geomorphological history of southern Africa elucidated by Partridge and Maud (1987), applied by Stuckenberg (1995) for interpretation of the geographical distribution of the genus *Vermipardus* (Diptera: Vermileonidae), it is possible to relate this to the occurrence of *Microchaetus* in the area between the Great Escarpment and the Indian Ocean.

The reinstatement of *Geogenia*, the genus initially proposed by Kinberg (1867) for *natalensis*, allows grouping twenty-one species as congeneric, some of which feature a diversity of anatomical conditions. Location of spermathecal pores in this genus is inconsistent, and occurs in post-testicular, testicular, or pre-testicular intersegmental furrows. Spermathecal placement in few furrows in post-testis positions is linked to shortened clitellum and tubercula pubertatis (as observed in *pondoana* and *natalensis*). Spermathecal presence in pre-testis segments is associated with elongated clitellum and long tubercula pubertatis, even if the pores occur in fewer furrows, as was observed in *quera* and *distasmosa* with pores only in 8/9, 9/10, in which the clitellum extends on 11–27 or 11–29, and tubercula pubertatis on 19–24 or 18,19–27,28.

G. benhami and *mkuzi* differ considerably from the congeners, having spermathecal pores in six furrows (10/11–15/16), including testicular segments, extended clitella on segments 10,11–28, and tubercula on 17–27 or 19–27. However, it is noteworthy that these two species although morphologically similar, are geographically distantly separated.

The occurrence of spermathecal pores in one or two intersegmental furrows observed in a group of *Geogenia* species (*caementerii*, *gripha*, *tegwana*, *pondoana*, *tuberosa*, *zaloumisi*), is also known in some species of the genus *Proandricus* with proandric features. The presence of spermathecal pores in fewer furrows in some of the *Geogenia* species corresponds also with some other variations. In *gripha* and *idechorita*, a proandric reduction of posterior pair of seminal vesicles occurs. In *tegwana*, beside a reduction of posterior pair of seminal vesicles, the posterior pair of vasa deferentia fuses with the anterior pair and run to male pores as simple ducts. These apomorphic variations evolved in species distantly allopatric, suggesting convergent adaptations. However, these species occur in KwaZulu-Natal sites sympatric with or close to proandric species, in which reduction of posterior pair of male gonads already took place.

A detailed study of species occurring in the western and south-western parts of South Africa, revealed a combination of distinctive features which warrant systematic recognition at the generic level. The 21 species listed above are now accommodated in the new genus *Kazimierzus*. These species, although sharing with *Microchaetus* and *Geogenia* species some of the common microchaetid characters, differ distinctly in their morphology and notably in geographical distribution (Fig. 3). This is essentially a genus of the winter-rainfall area, associated with topography of the western escarpment and with adjacent Namaqualand, bordering the Atlantic seaboard. This area is known for endemism in its invertebrate fauna, and is associated with highly diverse flora.

Variability in location of spermathecal pores in four, five or six always post-testis furrows, correlated with variations of the seminal vesicles and other unique characters, produced remarkable specific diversity in *Kazimierzus*. The metandric condition observed by Pickford (1975) in seminal vesicles, and subsequent recognition of the metandric species *metandricus*, and proandric or metandric variations occurring in male characters, reported by Plisko (1998), suggest apomorphic transformations that evolved in an ancestral holandric group of microchaetids.

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